

not enable a person "to include all" esters, ethers, olefins and/or alcohols "unrelated to the invention commensurate in scope with these claims" – is both improper and without legal foundation.

The Examiner's rational for this rejection does not question the operativeness of any ester, ether, olefin and/or alcohol. The Examiner cites to no evidence whatsoever which would give any reason to believe that any particular ester, ether, olefin and/or alcohol would be inoperative as an ester, ether, olefin and/or alcohol element of claim 1 and/or 2.

As MPEP § 2164.04 makes clear:

"A specification disclosure which contains a teaching of the manner and process of making and using an invention in terms which correspond in scope to those used in describing and defining the subject matter sought to be patented must be taken as being in compliance with the enablement requirement of 35 U.S.C. 112, first paragraph, unless there is a reason to doubt the objective truth of the statements contained therein which must be relied on for enabling support." (Emphasis added)

As MPEP § 2164.04 (a) makes clear:

"There are many factors to be considered when determining whether there is sufficient evidence to support a determination that a disclosure does not satisfy the enablement requirement and whether any necessary experimentation is "undue." These factors include, but are not limited to:

- (A) The breadth of the claims;
- (B) The nature of the invention;
- (C) The state of the prior art;
- (D) The level of one of ordinary skill;
- (E) The level of predictability in the art;
- (F) The amount of direction provided by the inventor;
- (G) The existence of working examples; and

- (H) The quantity of experimentation needed to make or use the invention based on the content of the disclosure.” (Emphasis added)

With the possible exception of factors (F) and/or (G) the Examiner’s basis for this rejection addresses none of the above factors. As to factors (F) and/or (G) the Examiner acknowledges that the specification and/or its working examples enable various esters, ethers, olefins and/or alcohols. This being so, the essence of the Examiner’s complaint is that for esters, ethers, olefins and/or alcohols not specifically named by the specification this disclosure is not enabling. But as MPEP § 2164.03 makes clear:

“The scope of the required enablement varies inversely with the degree of predictability involved, but even in unpredictable arts, a disclosure of every operable species is not required.” (Emphasis added)

In the absence of any reasoned basis in evidence for a reasonable belief that there exist some particular ester, ether, olefin and/or alcohol that would be inoperative in the context of that subject matter which claim 1 and/or 2 define, this basis for rejection must be withdrawn. In the absence of any reasoned basis in evidence for a belief that undue experimentation would be required in order to put into practice the invention defined by claim 1 and/or 2, this rejection must be withdrawn.

For the foregoing reasons, applicant respectfully submits that this basis for rejection should be withdrawn.

**Claim 3 Rejection Under 35 U.S.C. § 112, second paragraph**

The Examiner rejects claim 3, allegedly because of its use of the term “normal butanes.” Applicant’s copy of the application shows claim 3 to instead employ the term “normal butenes.” Assuming the Examiner intended this rejection to apply to the term “normal butenes,” applicant would note that this term would be understood by a person of ordinary skill in the art to describe a straight chain (“normal”) of four carbon atoms which has one site of unsaturation (a “butene”), i.e., a double bond, either between the first and second carbon atoms (“1-butene”) or between the second and third carbon atoms (“2-butene”).

Accordingly, claim 3 is not indefinite and requires no correction. This basis for rejection should be withdrawn.

**The Rejection Under 35 U.S.C. § 103 Of Claims 1-23 Over Jung (US 4,311,851) In View Of Takahashi (US 4,894,188)**

Contrary to, or complimentary of, the Examiner's statement concerning the teachings of Jung, applicant would note that Jung teaches a preparation of carboxylic acid esters by reaction of an olefin with carbon monoxide in the presence of a "catalyst complex" of  $\text{BF}_3 \cdot 1 \text{ ROH}$ . The carbonylation reaction of Jung is continued until half of the ROH of the  $\text{BF}_3 \cdot 1 \text{ ROH}$  "catalyst complex" is consumed and "catalyst complex" becomes a mixture of  $0.5 \text{ BF}_3 + 0.5 (\text{BF}_3 \cdot 1 \text{ ROH})$ . At this point the carbonylation reaction of Jung is stopped, i.e., CO is removed, and the so resulting reaction mass which comprises ester: alcohol:  $\text{BF}_3$  in a 1:1:2 molar ratio is worked up by first distilling off the free  $\text{BF}_3$  until the ratio of 1:1:1 is reached, then a quantity "X" of ROH is added to this first distilled mixture to yield a second mixture of a ratio of 1:1+X:1 and this second mixture is distilled into an overhead mixture of ester: alcohol of a molar ratio of 1:X-1 to leave as a second distillation bottom mixture alcohol:  $\text{BF}_3$  in a molar ratio of 2:1. To this second distillation bottom mixture, after extraction therefrom of heavy by products, sufficient  $\text{BF}_3$  is added to return the alcohol:  $\text{BF}_3$  molar ratio to 1:1 and this  $\text{BF}_3 \cdot 1 \text{ ROH}$  mixture is recycled to the carbonylation reactor as a "catalyst complex".

In effect the Examiner's rejection of claims 1-23 is an assertion by the Examiner that Jung itself teaches an acid composition comprising  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$  as a catalyst complex for production of esters via a reaction of carbon monoxide with an olefin. Applicant respectfully disagrees.

Jung does not teach a method of making an ester comprising contacting an olefin with carbon monoxide and an "acid composition comprising  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$ ." The acid composition which Jung teaches is one ranging from  $\text{BF}_3 \cdot 1.33 \text{ CH}_3\text{OH}$  to  $\text{BF}_3 \cdot 0.1 \text{ CH}_3\text{OH}$  (i.e., a  $\text{BF}_3$ :ROH ratio of 0.75:1 to 10:1). In so far as the  $\text{BF}_3 \cdot 1.33 \text{ CH}_3\text{OH}$  composition goes (where ROH =  $\text{CH}_3\text{OH}$ ) Jung suggest that such composition is a mixture of 67%  $\text{BF}_3 \cdot 1\text{CH}_3\text{OH} + 33\% \text{BF}_3 \cdot 2\text{CH}_3\text{OH}$ . Jung teaches that any "substantial amount" of  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$

contained in an acid composition comprising  $\text{BF}_3 \cdot 1\text{CH}_3\text{OH}$  is undesirable since  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$  is non selective to the desired product and of relatively low activity. Apparently 33%  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$  is the maximum tolerable amount of  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$  that Jung would allow his  $\text{BF}_3 \cdot 1\text{CH}_3\text{OH}$  catalyst to contain.

The catalyst of Jung is an acid composition comprising  $\text{BF}_3 \cdot 1\text{H}_2\text{O}$  whereas these claims call for an "acid composition comprising  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$ ."

The only point in the process described by Jung wherein an acid composition comprising  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$  is reached is achieved only long after the completion of the carbonylation reaction. Jung describes this process at columns 4-6 as follows:

The selection of the appropriate catalyst complex is an essential feature of the invention. As pointed out previously, the catalyst complex used in the instant invention contains equal molar amounts of  $\text{BF}_3$  and an alcohol. These catalysts are stable complexes having specific physical properties. They exist as liquids at room temperature and therefore can be conveniently used as the reaction solvent. (Col. 4, ln. 29-36)

While it is understood that the 1:1 molar ratio catalyst is the active constituent in the instant invention, the catalyst may be prepared using ratios of from about 0.75 to 10 moles of  $\text{BF}_3$  for each mole of the alcohol, preferably from 0.75 to 2 moles per mole. It will be understood that, when less than one mole of the  $\text{BF}_3$  is utilized with, say, methanol, the catalyst is a mixture of  $\text{BF}_3 \cdot \text{CH}_3\text{OH}$  and  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$ . This latter compound is also a stable complex; however, in contrast to the 1:1 molar ratio catalyst, it is non-selective to the desired product and of relatively low activity. Accordingly, a substantial amount of such complex is undesirable. (Col. 4, ln. 37-48)

To produce methyl isobutyrate, the carbonylation is continued until one-half of the methanol is consumed in the formation of the methyl isobutyrate product. The resulting product mixture has a composition consisting of methyl isobutyrate, methanol and  $\text{BF}_3$  in a molar ratio of about 1:1:2, along with some by-products as previously described. (Col. 5, ln. 28-34)

This reaction mass is stripped in a countercurrent contacting tower to separate half the  $\text{BF}_3$  contained therein as a vapor overhead product and to produce a residue product containing approximately equimolar amounts of methyl isobutyrate, methanol and  $\text{BF}_3$  (hereinafter the "1:1:1 complex") plus the by-products. . . . (Col. 5, ln. 35-40)

To separate the desired components, methanol is added to the 1:1:1 complex, preferably in a distillation zone. The amount of methanol added corresponds to at least that required to produce a methyl isobutyrate/methanol azeotrope as an overhead product and a bottoms product comprising a complex of  $\text{BF}_3$  / $\text{CH}_3\text{OH}$  in 1:2 molar ratio. The composition of this azeotrope, an (sic - at) atmospheric pressure, is 75 weight percent methanol, 25 weight percent methyl isobutyrate. This is equivalent to a methanol/methyl isobutyrate molar ratio of 9.56. Thus, if the distillation is conducted at ambient pressure, at least 10.56 additional moles of methanol must be added to the distillation zone. . . . (Col.6, ln.8-20)

The separation is conveniently carried out in a conventional continuous distillation column containing trays or packing. The 1:1:1 complex is generally fed near the middle of the column with the methanol added above this feed point. The distillate fraction from this column is a low boiling methanol/methyl isobutyrate azeotrope and any additional uncomplexed methanol. The bottoms product is a  $\text{BF}_3$  /methanol complex in 1:2 molar ratio. . . . (Col. 6, ln. 25-33)

The bottoms stream from the column comprises  $\text{BF}_3$  and methanol in 1:2 complex form and contains "heavy ends" products of the carbonylation reaction of the sort previously described. Removal of the by-products from the  $\text{BF}_3$  /methanol complex is carried out by continuous countercurrent liquid-liquid extraction, preferably using n-octane as the extracting solvent. The  $\text{BF}_3$  /methanol 1:2 complex is then reconstituted to the 1:1 complex, preferably via recombination with the  $\text{BF}_3$  originally separated from the reaction mass. The 1:1 complex is the active catalyst and it is recycled to the carbonylation reactor. (Col. 6, ln. 49-60)

From the above excerpts from Jung it is seen that Jung only achieves an acid composition comprising  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$  as a result of the distillation of a low boiling methanol/methyl isobutyrate azeotrope to yield as a bottom product of such distillation a composition which comprises  $\text{BF}_3$  and methanol in 1:2 complex form. But Jung does not use this  $\text{BF}_3$  and methanol in 1:2 complex form as a catalyst for the carbonylation reactor because, as Jung points out, it is non-selective to the desired product, is of relatively low activity and a substantial amount of such complex is undesirable.

Nothing in Jung suggests or motivates one to contact an olefin and carbon monoxide with an "acid composition comprising  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$ ". From Jung one would expect an acid composition comprising  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$  to be an ineffective catalyst to be avoided. Jung teaches  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$  to be non-selective of relatively low activity, and therefore undesirable. Given this express teaching by Jung one skilled in the art would have no reason to expect  $\text{BF}_3 \cdot 2\text{H}_2\text{O}$  "to have the similar reaction condition" as the Examiner has asserted. In fact Jung itself states that  $\text{BF}_3 \cdot 2\text{H}_2\text{O}$  does not have similar reaction conditions to that of  $\text{BF}_3 \cdot 1\text{H}_2\text{O}$ .

This deficiency of Jung is not cured by any disclosure to be found in Takahashi '188. The Examiner asserts that Takahashi '188 indicates that boron trifluoride may be used extensively in the reaction process, and identifies col. 1, lines 17-21 as the basis for this assertion. The one and only mention of boron trifluoride in Takahashi '188 occurs in the sentence at Col. 1, lines 14-21, as follows:

The reactions for obtaining a fatty acid having one more carbon atoms than the starting compound or a derivative of said fatty acid by reacting an olefin, carbon monoxide and water or reacting an alcohol or its derivative and carbon monoxide in the presence of an acid catalyst such as sulfuric acid, hydrogen fluoride, boron trifluoride or the like are extensively known as Koch reaction or Koch-like reaction.

The invention of Takahashi '188 itself uses only hydrogen fluoride as a catalyst. So the above lone sentence stands as the only thing in Takahashi '188 that could possibly serve as a basis for modifying the catalyst of Jung from that of an acid

composition comprising  $\text{BF}_3 \cdot \text{H}_2\text{O}$  in to that of an acid composition comprising  $\text{BF}_3 \cdot 2\text{H}_2\text{O}$  as these claims require. But one following the teachings of the above sentence in Takahashi '188 to use boron trifluoride as a catalyst for a Koch-like reaction according to a Jung like process would have no reason to go against the teaching of Jung that  $\text{BF}_3 \cdot 2\text{H}_2\text{O}$  is to be avoided and  $\text{BF}_3 \cdot \text{H}_2\text{O}$  is to be used. The above teaching of Takahashi '188 is followed by using the  $\text{BF}_3 \cdot \text{H}_2\text{O}$  catalyst of Jung, and the above teaching of Takahashi '188 motivates no change to the  $\text{BF}_3 \cdot \text{H}_2\text{O}$  catalyst of Jung.

The basic requirements of a prima facie case of obviousness are set forth in the MPEP § 2143 as follows:

“To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).”

In as much as these basic requirements are lacking in the grounds stated for rejection of claims 1-23 it is respectfully submitted that the rejection of claims 1-23 must be withdrawn.

**The Rejection Under 35 U.S.C. § 103 Of Claims 24-35 Over Takahashi (US 4,894,188) In View Of Jung (US 4,311,851)**

Claims 24-35 are directed to a method for making methyl pivalate by contacting methyl-t-butyl ether (MTBE) with carbon monoxide and an acid composition comprising  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$  and separating an acid product comprising  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$  from the methyl pivalate.

The Examiner asserts that Takahashi '188 teaches the reaction of carbon monoxide with MTBE in the presence of a  $\text{BF}_3$  catalyst. But there simply is no such teaching in Takahashi '188. The one and only mention of boron trifluoride in Takahashi '188 occurs in the sentence at Col. 1, lines 14-21, as follows:

The reactions for obtaining a fatty acid having one more carbon atoms than the starting compound or a derivative of said fatty acid by reacting an olefin, carbon monoxide and water or reacting an alcohol or its derivative and carbon monoxide in the presence of an acid catalyst such as sulfuric acid, hydrogen fluoride, boron trifluoride or the like are extensively known as Koch reaction or Koch-like reaction.

The only reactants described in this sentence are olefin,  $\text{CO}$ ,  $\text{H}_2\text{O}$ , alcohol. Ethers of any kind simply are not mentioned or suggest by this sentence.

Takahashi '188 describes MTBE in connection with his invention (Col. 2, lines 15-25) and his invention clearly is limited to an  $\text{HF}$  catalyst. There is nothing in Takahashi '188 to suggest that a catalyst other than  $\text{HF}$ , such as the  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$  here claimed, could or should be used in the process of Takahashi '188. This would destroy the essence of the invention of Takahashi '188. The reasons advanced in response to the rejection of claims 1-23 are equally applicable to the rejection of claims 24-35. Jung teaches against the use of  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$  in a carbonylation reaction that would produce methyl pivalate from methyl-t-butyl ether (MTBE) and carbon monoxide. Nothing in Takahashi '188 cures this deficiency of Jung. Likewise there is nothing in the disclosure of Jung that would motivate a modification of the process of Takahashi '188 to cause a change from its  $\text{HF}$  catalyst to an acid composition comprising  $\text{BF}_3 \cdot 2\text{CH}_3\text{OH}$ .

The basic requirements of a prima facie case of obviousness are lacking and it is respectfully submitted that the rejection should be withdrawn.



### CONCLUSION

It is respectfully submitted that all issues and rejections have been adequately addressed and that all claims pending are allowable and that the case should be advanced to issuance.

If the Examiner has any questions or wishes to discuss the claims, the Examiner is encouraged to call the undersigned at the telephone number indicated below.

Respectfully submitted,

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